Amendment to Claims

This listing of Claims will replace all prior versions and listings of claims in this Application.

Listing of Claims

Claim 1. (CURRENTLY AMENDED) A method of selectively depositing a ferroelectric thin film on an indium-containing substrate in a ferroelectric device comprising:

preparing a silicon substrate;

depositing an indium-containing thin film on the substrate;

patterning the indium containing thin film;

annealing the structure;

selectively depositing a ferroelectric layer by MOCVD; and

annealing the structure; and

~~completing the ferroelectric device.~~

Claim 2. (ORIGINAL) The method of claim 1 wherein said preparing includes forming an oxide layer on the silicon substrate.

Claim 3. (ORIGINAL) The method of claim 1 wherein said preparing includes forming a high-k oxide on the silicon substrate.

Claim 4. (ORIGINAL) The method of claim 1 wherein said patterning includes etching the indium-containing thin film.

Claim 5. (ORIGINAL) The method of claim 1 wherein said patterning the indium-containing thin film includes forming a silica dioxide trench structure.

Claim 6. (ORIGINAL) The method of claim 1 wherein said depositing of an indium-containing thin film includes deposition of a In_2O_3 thin film, and which further includes depositing the In_2O_3 thin film on a substrate at a deposition temperature of between about 20°C to 300°C and a substrate temperatures of between about 20°C to 200°C; a chamber pressure of between about 1 torr to 10 torr; an oxygen partial pressure of between about 0% to 60%; a DC sputtering power of between about 200 W to 300 W, and a backward power less than 1%; and post-annealing at a temperature of between about 400°C to 800°C for between about 5 minutes to 60 minutes in an oxygen atmosphere.

Claim 7. (ORIGINAL) The method of claim 1 wherein said selectively depositing a ferroelectric layer includes depositing a PGO layer includes preparing a PGO precursor of $[Pb(thd)_2]$ and $[Ge(ETO)_4]$, where thd is $C_{11}H_{19}O_2$ and ETO is OC_2H_5, having a molar ratio of between about 5 to 5.5:3, which is dissolved in a mixed solvent of butyl ether or tetrahydrofuran, isopropanol and tetraglyme in the molar ratio of about 8:2:1to form a precursor solution; wherein the precursor solution has a concentration of 0.1 M/L of PGO; injecting precursor solution into a vaporizer of the MOCVD reactor at a temperature of between about 150°C to 240°C at a rate of between about 0.02 ml/min to 0.2 ml/min to form a precursor gas; maintaining a precursor gas feed line at a temperature of between about 150°C to 245°C during MOCVD; maintaining the MOCVD reactor at a temperature of between about 500°C to 560°C; a pressure of between

about 1 torr. to 10 torr.; an oxygen partial pressure of between about 30% - 50%; a vaporizer temperature of between about 200°C to 240°C; a precursor solution delivery rate of between about 0.1 ml/min- 0.2 ml/min; a deposition time of between about 1 hour to 3 hours; an annealing temperature of between about 500°C to 560°C; and an annealing time of between about 5 minutes to 30 minutes in an oxygen atmosphere.

Claim 8. (ORIGINAL) The method of claim 6 wherein said selectively depositing a ferroelectric layer includes depositing a PGO layer which further includes preparing a PGO precursor of $[Pb(thd)_2]$ and $[Ge(ETO)_4]$, where thd is $C_{11}H_{19}O_2$ and ETO is OC_2H_5, having a molar ratio of between about 5 to 5.5:3, which is dissolved in a mixed solvent of butyl ether or tetrahydrofuran, isopropanol and tetraglyme in the molar ratio of about 8:2:1to form a precursor solution; wherein the precursor solution has a concentration of 0.1 M/L of PGO; injecting precursor solution into a vaporizer of the MOCVD reactor at a temperature of between about 150°C to 240°C at a rate of between about 0.02 ml/min to 0.2 ml/min to form a precursor gas; maintaining a precursor gas feed line at a temperature of between about 150°C to 245°C during MOCVD; forming the PGO layer in a first, nucleation step, using a deposition temperature of between about 500°C to 560°C for between about 5 minutes to 20 minutes; followed by a second, growth step which includes selective PGO deposition at a deposition temperature of between about 500°C to 560°C; a deposition reactor pressure of between about 1 torr. to 10 torr.; an oxygen partial pressure of between about 30% - 50%; a vaporizer temperature of between about 200°C to 240°C; a precursor solution delivery rate of between about 0.1 ml/min-0.2 ml/min; a deposition time of between about 1 hour to 3 hours; annealing the PGO layer at an

annealing temperature of between about 500°C to 560°C; and an annealing time of between about 5 minutes to 30 minutes in an oxygen atmosphere.

Claim 9. (ORIGINAL) A method of selectively depositing a ferroelectric thin film on an indium-containing substrate in a ferroelectric device comprising:

preparing a silicon substrate;

depositing an In_2O_3 thin film having a thickness of between about 10 nm and 2 μm on the substrate;

patterning the In_2O_3 thin film;

annealing the structure;

selectively depositing a PGO layer by MOCVD on the In_2O_3 thin film; and

annealing the structure; and

completing the ferroelectric device.

Claim 10. (ORIGINAL) The method of claim 9 wherein said preparing includes forming an oxide layer on the silicon substrate.

Claim 11. (CURRENTLY AMENDED) The method of claim 9 wherein said preparing includes forming a high-k oxide on the silicon substrate, wherein the high-k material is taken from the group of materials consisting of HfO, ZrO, Al_2O_3, La_2O_3, and alloys thereof.

Claim 12. (ORIGINAL) The method of claim 9 wherein said patterning includes etching the

In_2O_3 thin film.

Claim 13. (ORIGINAL) The method of claim 9 wherein said patterning the In_2O_3 thin film includes forming a silica dioxide trench structure.

Claim 14. (ORIGINAL) The method of claim 9 wherein said depositing a In_2O_3 thin film includes depositing the thin film on a substrate at a deposition temperature of between about 20°C to 300°C and a substrate temperatures of between about 20°C to 200°C; a chamber pressure of between about 1 torr to 10 torr; an oxygen partial pressure of between about 0% to 60%; a DC sputtering power of between about 200 W to 300 W, and a backward power less than 1%; and post-annealing at a temperature of between about 400°C to 800°C for between about 5 minutes to 60 minutes in an oxygen atmosphere.

Claim 15. (ORIGINAL) The method of claim 9 wherein said selectively depositing a PGO layer includes preparing a PGO precursor of $[Pb(thd)_2]$ and $[Ge(ETO)_4]$, where thd is $C_{11}H_{19}O_2$ and ETO is OC_2H_5, having a molar ratio of between about 5 to 5.5:3, which is dissolved in a mixed solvent of butyl ether or tetrahydrofuran, isopropanol and tetraglyme in the molar ratio of about 8:2:1to form a precursor solution; wherein the precursor solution has a concentration of 0.1 M/L of PGO; injecting precursor solution into a vaporizer of the MOCVD reactor at a temperature of between about 150°C to 240°C at a rate of between about 0.02 ml/min to 0.2 ml/min to form a precursor gas; maintaining a precursor gas feed line at a temperature of between about 150°C to 245°C during MOCVD; maintaining the MOCVD reactor at a temperature of

between about 500°C to 560°C; a pressure of between about 1 torr. to 10 torr.; an oxygen partial pressure of between about 30% - 50%; a vaporizer temperature of between about 200°C to 240°C; a precursor solution delivery rate of between about 0.1 ml/min- 0.2 ml/min; a deposition time of between about 1 hour to 3 hours; an annealing temperature of between about 500°C to 560°C; and an annealing time of between about 5 minutes to 30 minutes in an oxygen atmosphere.

Claim 16. (ORIGINAL) The method of claim 9 wherein said selectively depositing a PGO layer includes preparing a PGO precursor of $[Pb(thd)_2]$ and $[Ge(ETO)_4]$, where thd is $C_{11}H_{19}O_2$ and ETO is OC_2H_5, having a molar ratio of between about 5 to 5.5:3, which is dissolved in a mixed solvent of butyl ether or tetrahydrofuran, isopropanol and tetraglyme in the molar ratio of about 8:2:1to form a precursor solution; wherein the precursor solution has a concentration of 0.1 M/L of PGO; injecting precursor solution into a vaporizer of the MOCVD reactor at a temperature of between about 150°C to 240°C at a rate of between about 0.02 ml/min to 0.2 ml/min to form a precursor gas; maintaining a precursor gas feed line at a temperature of between about 150°C to 245°C during MOCVD; forming the PGO layer in a first, nucleation step, using a deposition temperature of between about 500°C to 560°C for between about 5 minutes to 20 minutes; followed by a second, growth step which includes selective PGO deposition at a deposition temperature of between about 500°C to 560°C; a deposition reactor pressure of between about 1 torr. to 10 torr.; an oxygen partial pressure of between about 30% - 50%; a vaporizer temperature of between about 200°C to 240°C; a precursor solution delivery rate of between about 0.1 ml/min- 0.2 ml/min; a deposition time of between about 1 hour to 3 hours;

annealing the PGO layer at an annealing temperature of between about 500°C to 560°C; and an annealing time of between about 5 minutes to 30 minutes in an oxygen atmosphere.

Claim 17. (NEW) A method of selectively depositing a ferroelectric thin film on an indium-containing substrate in a ferroelectric device comprising:

preparing a silicon substrate;

forming a silicon oxide layer on the silicon substrate

depositing an In_2O_3 layer having a thickness of between about 10 nm and 2 μm on the silicon oxide layer;

patterning the In_2O_3 layer, including etching the In_2O_3 layer, leaving the silicon oxide layer surrounding the In_2O_3 layer;

annealing the structure;

selectively depositing a PGO layer by MOCVD on the In_2O_3 layer wherein MOCVD of PGO on the In_2O_3 layer is about two orders of magnitude greater than that of MOCVD of PGO on the surrounding silicon oxide layer, thus depositing the PGO to the desired form on the In_2O_3 layer and eliminating the need for etching of the PGO layer; and

annealing the structure.

Claim 18. (NEW) The method of claim 17 wherein said depositing a In_2O_3 thin film includes depositing the thin film on a substrate at a deposition temperature of between about 20°C to 300°C and a substrate temperatures of between about 20°C to 200°C; a chamber pressure of between about 1 torr to 10 torr; an oxygen partial pressure of between about 0% to 60%; a DC

sputtering power of between about 200 W to 300 W, and a backward power less than 1%; and post-annealing at a temperature of between about 400°C to 800°C for between about 5 minutes to 60 minutes in an oxygen atmosphere.

Claim 19. (NEW) The method of claim 17 wherein said selectively depositing a PGO layer includes preparing a PGO precursor of $[Pb(thd)_2]$ and $[Ge(ETO)_4]$, where thd is $C_{11}H_{19}O_2$ and ETO is OC_2H_5, having a molar ratio of between about 5 to 5.5:3, which is dissolved in a mixed solvent of butyl ether or tetrahydrofuran, isopropanol and tetraglyme in the molar ratio of about 8:2:1to form a precursor solution; wherein the precursor solution has a concentration of 0.1 M/L of PGO; injecting precursor solution into a vaporizer of the MOCVD reactor at a temperature of between about 150°C to 240°C at a rate of between about 0.02 ml/min to 0.2 ml/min to form a precursor gas; maintaining a precursor gas feed line at a temperature of between about 150°C to 245°C during MOCVD; maintaining the MOCVD reactor at a temperature of between about 500°C to 560°C; a pressure of between about 1 torr. to 10 torr.; an oxygen partial pressure of between about 30% - 50%; a vaporizer temperature of between about 200°C to 240°C; a precursor solution delivery rate of between about 0.1 ml/min- 0.2 ml/min; a deposition time of between about 1 hour to 3 hours; an annealing temperature of between about 500°C to 560°C; and an annealing time of between about 5 minutes to 30 minutes in an oxygen atmosphere.

Claim 20. (NEW) The method of claim 17 wherein said selectively depositing a PGO layer includes preparing a PGO precursor of $[Pb(thd)_2]$ and $[Ge(ETO)_4]$, where thd is $C_{11}H_{19}O_2$

and ETO is OC_2H_5, having a molar ratio of between about 5 to 5.5:3, which is dissolved in a mixed solvent of butyl ether or tetrahydrofuran, isopropanol and tetraglyme in the molar ratio of about 8:2:1to form a precursor solution; wherein the precursor solution has a concentration of 0.1 M/L of PGO; injecting precursor solution into a vaporizer of the MOCVD reactor at a temperature of between about 150°C to 240°C at a rate of between about 0.02 ml/min to 0.2 ml/min to form a precursor gas; maintaining a precursor gas feed line at a temperature of between about 150°C to 245°C during MOCVD; forming the PGO layer in a first, nucleation step, using a deposition temperature of between about 500°C to 560°C for between about 5 minutes to 20 minutes; followed by a second, growth step which includes selective PGO deposition at a deposition temperature of between about 500°C to 560°C; a deposition reactor pressure of between about 1 torr. to 10 torr.; an oxygen partial pressure of between about 30% - 50%; a vaporizer temperature of between about 200°C to 240°C; a precursor solution delivery rate of between about 0.1 ml/min- 0.2 ml/min; a deposition time of between about 1 hour to 3 hours; annealing the PGO layer at an annealing temperature of between about 500°C to 560°C; and an annealing time of between about 5 minutes to 30 minutes in an oxygen atmosphere.